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MICROBIOLOGICAL STATIONS IN THE STUDY OF OIL DEPOSITS

The microbiological detail of the Institute of Microbiology which took part in the complex expedition of the Petroleum Institute of the Academy of Sciences USSR has returned. The work carried out by them involved the study of microbiological processes in the decomposition of organic substances in "buried" deposits.

In conducting geological explorations in search of oil it is essential to know whether the combustible gases are formed because of the decomposition of the oil or whether the oil may be formed from the combustible gases through their condensation under the high pressures which normally exist in oil deposits. In the first case, the presence of gas may serve as an indication of large oil deposits; in the second case, it is impossible to count on the presence of any appreciable deposits of oil.

To the work of geologists and chemists in this field have been added the efforts of microbiologists. They considered that in case methane, the basic component of combustible gases, is formed because of the decomposition of oil, then there would have to be found, in the water layers below the oil deposits, organisms which break down the hydrocarbons of the oil to form methane. In case the methane is not formed as a result of a breakdown of the oil, then its source could be the decomposition of fatty acids or the process of condensation of hydrogen and carbon dioxide.

The first group of the detail, under the leadership of Doctor of Biological Sciences S. I. Kuznetsov, removed core samples of rock from the locality of gas-oil fields and analyzed the samples for the occurrence of various bacteria which might take part in the following phenomena: (1) breakdown of heptane with formation of gas; (2) breakdown of fatty acids with formation of gas; (3) condensation of hydrogen and carbonic acid into methane; and (4) oxidation of organic substances through reduction of sulfates. Preliminary data showed that the Permian deposits of the Kazanskiy and Kungurskiy strata are characterized by a vigorous process of reduction of sulfates which flow in the water below the petroleum layers.

It appears that hydrocarbons will serve as a source of organic matter for the desulfurizing bacteria since this process was also found in cultures where the only source of carbon was heptane. Contemporary processes of methane formation, according to the data of microbiological analysis, can take place only in the deposits of the Kungurskiy layer. Here, condensation of carbon dioxide and hydrogen can take place on the rocks with subsequent breakdown of compounds of the fatty acid type and formation of methane.

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Bacteria capable of breaking down the petroleum with formation of gas were observed only in media with nitrates. In these cultures, after a month of incubation, the oil was completely saturated with gas bubbles. However, in cultures with ammonium nitrate, gas did not form. This gives a basis for supposing that the gas bubbles consist of nitrogen and were formed as a result of denitrification, and the oil itself serves only as a source of organic matter for these bacteria. In the deposits of the carbonaceous period there were no indications whatsoever of organisms capable of breaking down the oil with formation of gases. Four core samples from the Devonian deposits were analyzed without any indication of oil; they all appeared to be without life. Thus, nowhere were there any signs of microorganisms capable of breaking down oil with formation of combustible gases.

The second group of the detail, which included L. D. Shturm and Yu. I. Sorokin, investigated the water below the petroleum layers of oil fields and provided the comparative characteristic of the microflora in these waters in the Devonian and lower carboniferous deposits. In a number of cases, the water beneath the petroleum layers contained an enormous quantity of bacteria -- up to 7 million per cubic centimeter, including up to 10,000 per liter of the sulfate-reducing type. This in itself is an indication of the significance of microbiological factors in investigations of oil deposits.

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